Heartland Corridor, Walton Virginia to Columbus Ohio

Preliminary Engineering Phase Report

Roderfield
Tunnel
MP N413.07
Roderfield, WV

October 14, 2005, Rev. 2

Hatch Mott MacDonald

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Norfolk Southern Railway
Heartland Corridor, Walton VA to Columbus OH

Roderfield Tunnel – MP N413.07

Statistics: Pocahontas Division
Double-width Tunnel for Main #1 and Main #2
Length = 924'
Concrete lined
Tangent track (per Track Chart)
Superelevation = 0.0" (per Track Chart)

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1. EXISTING CONDITIONS

1.1 Background

Valuation maps V-13-WV/37 (16293) and V-13-WV/38 (1629301) for the Roderfield Tunnel are dated June 30, 1916. The parcel for the tunnel was acquired in 1907. A Norfolk Southern tunnel inspection sheet for Roderfield Tunnel references drawing Y-3338. This drawing is dated June 10, 1905. Drawing Y-3338 applies to tunnels on tangent track (such as Roderfield) and shows typical portal and lining construction. Construction of the tunnel was completed in 1909 based on the date stamped on the portal. Additional information on this tunnel was obtained from various sources such as topographic maps, aerial photos, inspection reports, track charts, and field investigations that were performed on March 25, June 14, July 5, and July 6, 2005.

1.2 General Area

The tunnel is located in Roderfield, WV. Nearby land use includes residential areas in the general area of the portals. The Roderfield Volunteer Fire Department is located near the east portal. The east portal can be accessed from County Road (CR) 7. There is limited access to the west portal by driving on small roads through a cemetery. There is a spur track crossing CR 7 near the east portal and some room for staging. There are rail bridges in close proximity to the east and west portals crossing over CR 7 and the Tug Fork River on the east side and crossing over the Tug Fork River on the west side. A hot box detector is located outside the east portal just east of the bridge.

1.3 Structural Conditions

The tunnel is 924’ long with a concrete liner and a nominal width of 28’. It is a double width tunnel for two tracks. The tunnel is in generally good condition; joints at the portals are wet with the rest of the tunnel dry. A track circuit cable is mounted on the south wall of the tunnel.

Liner cores were taken on July 5 and 6, 2005. Cores were drilled into the liner at locations 250’ and 750’ into the tunnel from the east portal. The cores were taken at the 7 o’clock and 10 o’clock position at 250’, and at the 7, 10, and 12 o’clock positions at 750’. A borescope was inserted into the holes to view inside the liner. The video from the borescope was recorded onto a DVD. The liner probe investigation is summarized in the table below:

Summary of Roderfield Tunnel Liner Core Investigation

Distance from East Portal	Position	Liner Thickness	Notes
250’	7 o’clock	31”	Hole was ~10’ up on left wall. Entire depth of hole was concrete. Did not drill through liner.

Summary of Roderfield Tunnel Liner Core Investigation			
Distance from East Portal	**Position**	**Liner Thickness**	**Notes**
250’	10 o’clock	-	Hole was incomplete. Lost track time while drilling this hole.
750’	7 o’clock	33.5”	Hole was ~4’ up on left wall. Entire depth of hole was concrete. Did not drill through liner.
750’	10 o’clock	40”	Entire 40” hole was all concrete. Did not drill through liner.
750’	12 o’clock	36”	Immediately behind 36” of concrete was broken rock. 9” into the hole, the core went through a square steel rod.

Two samples of concrete from the liner core investigation were saved and tested. The sample from the 750’, 10 o’clock position, taken about 2.5’ into the core, had a compressive strength of 3,625 psi. The sample from the 750’, 12 o’clock position, taken about 1’ into the core, had a compressive strength of 5,330 psi.

Excavation was done to expose a small portion of the tunnel liner footing. The footing thickness was found to be 16”. The vertical distance from the top of rail to the base of the footing was measured at 33”.

The bridges outside of the tunnel were investigated on June 14, 2005. The bridge located at the east portal is a 4-span timber deck girder. The girders are built-up steel plate girders with the south pair of girders carrying Main #1, and the north pair carrying Main #2. The girders bear directly on the abutments. The bridge spans County Road 7 and Tug Fork River. The road has a steep grade in order to pass under this bridge. The structure type and site geometry, coupled with the proximity of rock below the rail make track lowering a difficult and expensive option. The bridge located at the west portal is also a timber deck girder bridge.

1.4 Track

The track is of conventional design with wood crossties and a stone ballast section. The rail is continuously welded 132 RE with a tie spacing of 19” on 18” tie plates spiked to every tie. The track is tangent throughout the entire length of the tunnel. The ballast is approximately 2’ deep from the top of the ties and is in generally poor condition, with fouling noted in multiple areas. The fouled ballast indicates that the drainage in this tunnel is a problem. Ballast from Roderfield was not tested, however the ballast at this tunnel is similar to the ballast at the nearby Twin Branch No. 1 Tunnel. The ballast from Twin Branch No. 1 was tested and classified as being “Very Strong”, requiring many blows of a geological hammer to break intact rock specimens.

During the March 25, 2005 inspection it was observed that as trains cross the east end of the bridge at MP N-413.26 on Main #1, the rail deflected approximately 2" immediately adjacent to the bridge. It was noted that there are welds in short sections of the track in this area indicating previous problems with the rail cracking due to this deflection. The flagman noted this condition.

1.5 Geotechnical

The tunnels in the east-central part of the Pocahontas Division (including Roderfield) are located in the Appalachian Plateaus Physiographic Province, a region characterized by deeply incised plateaus underlain by flat-lying sedimentary rock. The tunnel itself is lined and no rock was exposed. The description of the site geology at each tunnel is based on our observations of the rockmass at the portals and adjacent cuts and the 1968 West Virginia Geologic Map prepared by the West Virginia Geologic and Economic Survey.

The tunnel was excavated through the medium- to thick-bedded fine-to medium grained sandstone of the New River Formation. The sandstone is locally interbedded with thin-bedded sandstone, siltstone, shale, and coal. Bedding is subhorizontal and gently rolls back and forth towards the northwest and southeast. Joints in the rock cuts of the formations are typically steeply dipping and widely spaced. Most joints are less than 15 feet in length and are not through-going across the exposure face.

The rock quality designation, Q, at the portals was determined to be 23. A Q rating between 10 and 40 is considered "Good" with 10 bordering on "Fair" and 40 bordering on "Very Good."

The geoprobes indicate that the top of rock is located between 2.5' to 4.5' (averaging about 3.5') below the top of ballast throughout the tunnel for Main #1 and between 1.9' to 4.4' (averaging about 3.4') below the top of ballast throughout the tunnel for Main #2. Top of ballast is typically about 0.8' below top of low rail.

1.6 Clearances

The laser car measurements indicate that the existing tunnel has adequate horizontal clearance for both the "High-Wide Load" and the "Double-Stack Load" portions of the composite clearance envelope throughout the tunnel. For vertical clearance, the "Double Stack" portion of the envelope encroaches on both sides of the tunnel crown for the entire length of the tunnel. The encroachment is similar on both sides, averaging about 11" (varies 10" to 12") on the left side and averaging about 14" (varies 11" to 16") on the right side. The "High-Wide" portion of the envelope encroaches by similar amounts on both sides of the tunnel crown (at points lower than the "Double Stack" portion) by an average of about 5". Cross sections of the tunnel clearance encroachments are shown in the drawings at the end of this report. The maximum vertical encroachments are summarized in the table below:

	Crown Encroachment (radial inches)	
Distance (ft) From East Portal	Left Side	Right Side
0	11	16
103	10	15
202	10	16
301	11	16
402	11	13
501	12	13
603	12	13
701	11	12
804	10	12
901	11	13

2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the vertical clearance deficiency, there are several general alternatives that can be used to obtain the clearance; replacing the lining, notching the lining or using steel ties to lower the track. Combinations of the general methods may be required to obtain a design that is cost effective and that can be constructed within reasonable track outages. Track lowering by excavating or undercutting does not appear feasible due to the proximity of the top of rock to the surface.

2.1 Liner Replacement

With this method, to obtain the desired clearance the concrete liner at the crown must be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed. However, the magnitude of encroachment does not appear to be enough to warrant liner replacement.

2.2 Notching the Crown

Notching in the upper quadrants of the tunnel would not cut entirely through the liner and would be a more economical alternative to complete liner replacement. Considering that the average vertical encroachment for the “Double Stack” portion of the envelope is currently between 11” and 14”, rock dowels and a deep notching scheme will be necessary. This method is a feasible alternative for encroachments up to 16”, which is equal to the maximum encroachment for this tunnel. The deep notching method on its own could solve the clearance problems, or, alternatively, steel ties could be used to reduce the depth of the notch.

2.3 Steel Ties

Substitution of steel ties for the standard wood ties would permit the rails to be lowered about 6 inches. Transition sections would be constructed at the tunnel approaches and into the east

portal for the vertical curves and for a gradual transition in track stiffness. A proper drainage system is required to minimize corrosion of the ties.

Steel ties would not be sufficient to fix the entire clearance deficiencies but could be used in conjunction with notching to reduce the depth of the notch. However, with or without steel ties the notch would still be a deep notch, requiring rock dowels, so no benefit is gained by the method changing from deep to minor notching. If steel ties are incorporated to lower the track, the bridges at each portal would need to be lowered as well. The bridge investigation showed that lowering the bridges would require significant structural modifications. Also, lateral shifting of the track is a concern when using steel ties. For these reasons, the small benefit gained by using steel ties would not warrant the additional costs, and this alternative will no longer be considered.

3. PREFERRED ALTERNATIVE

Given the magnitude of the vertical encroachment, installing rock dowels and using the deep notching method is the most feasible and economical solution to provide adequate vertical clearance throughout the tunnel. Drainage improvements are also recommended to help alleviate the ballast-fouling problem.

3.1 Preliminary Design

The preliminary design uses Deep Notching. The existing track structure is planned to be flooded with ballast to the top of the rail to provide access into the tunnel for the contractor to work and to protect the track during the construction. The preliminary design also proposes to install a new drainage system and undercut the track to replace the fouled ballast.

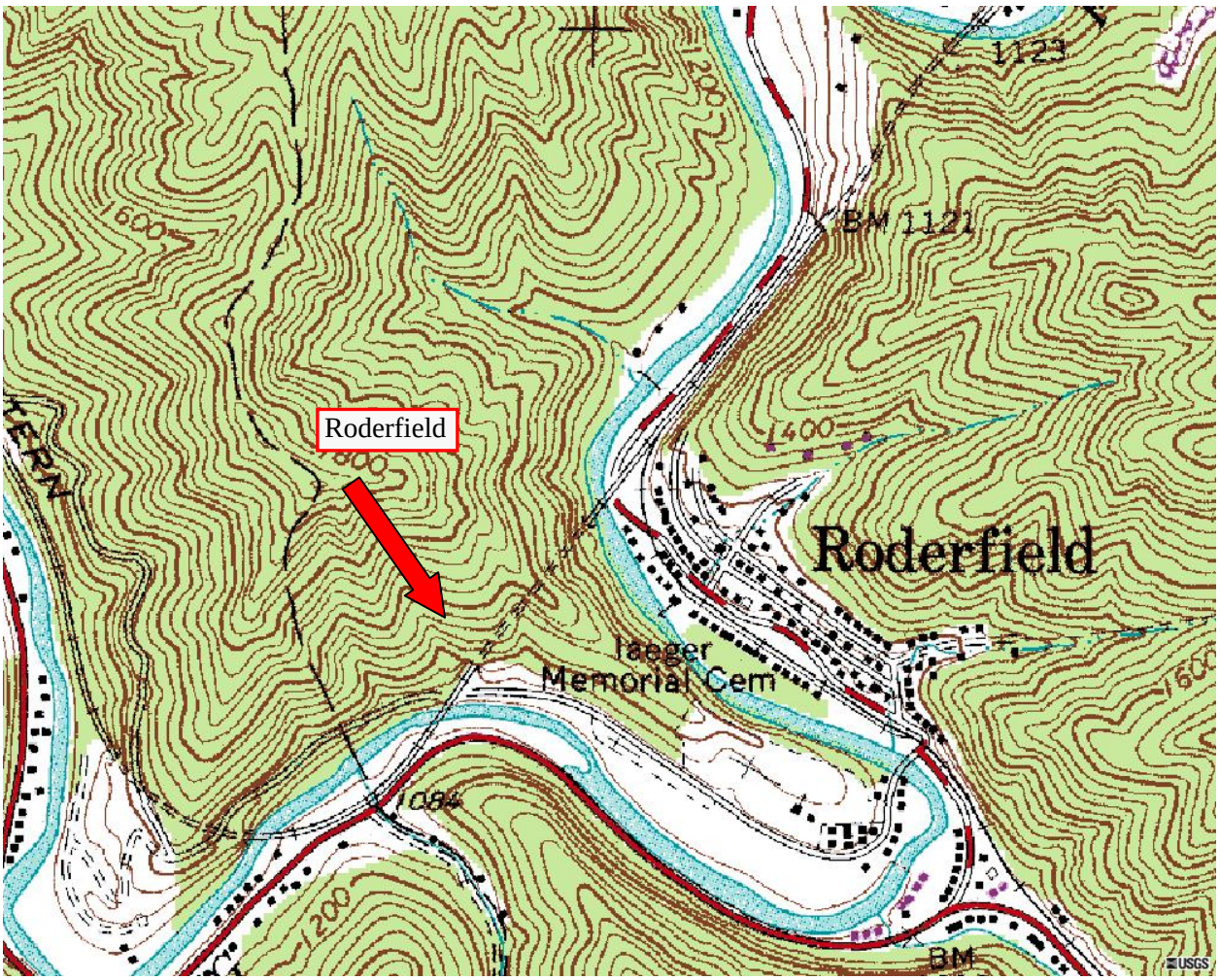
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is twelve (12) weeks from mobilization to demobilization. The schedule assumes that one track is closed at a time, for ten hours, five days a week. The installation of rock dowels at a given location would precede the deep notching, but the two operations could occur within the tunnel at different locations at the same time. Likewise, drainage improvement operations would also be undertaken at the same time.

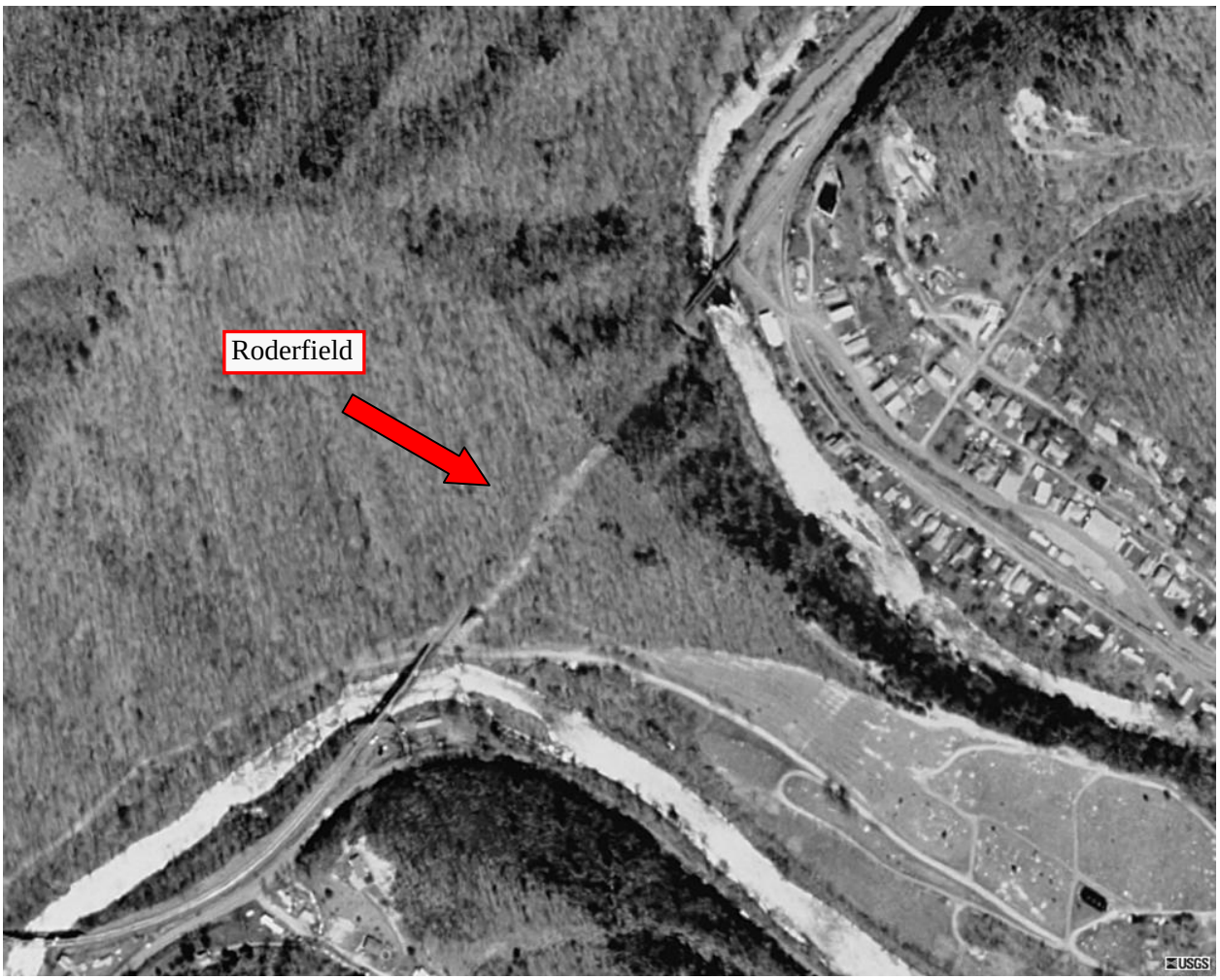
3.3 Estimate

The total estimated cost for achieving clearance at this location is $2.1 million(2005 rates) or $2,316 per foot of tunnel. The work items include mobilization, surveying, rock dowels, deep notching, rock cut for drainage trench, tunnel drainage system, ballast cleaning, and demobilization. An allowance for grouting the invert void was also included. The total cost is made up of tunnel, track, signal and site work items at $1.3 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO



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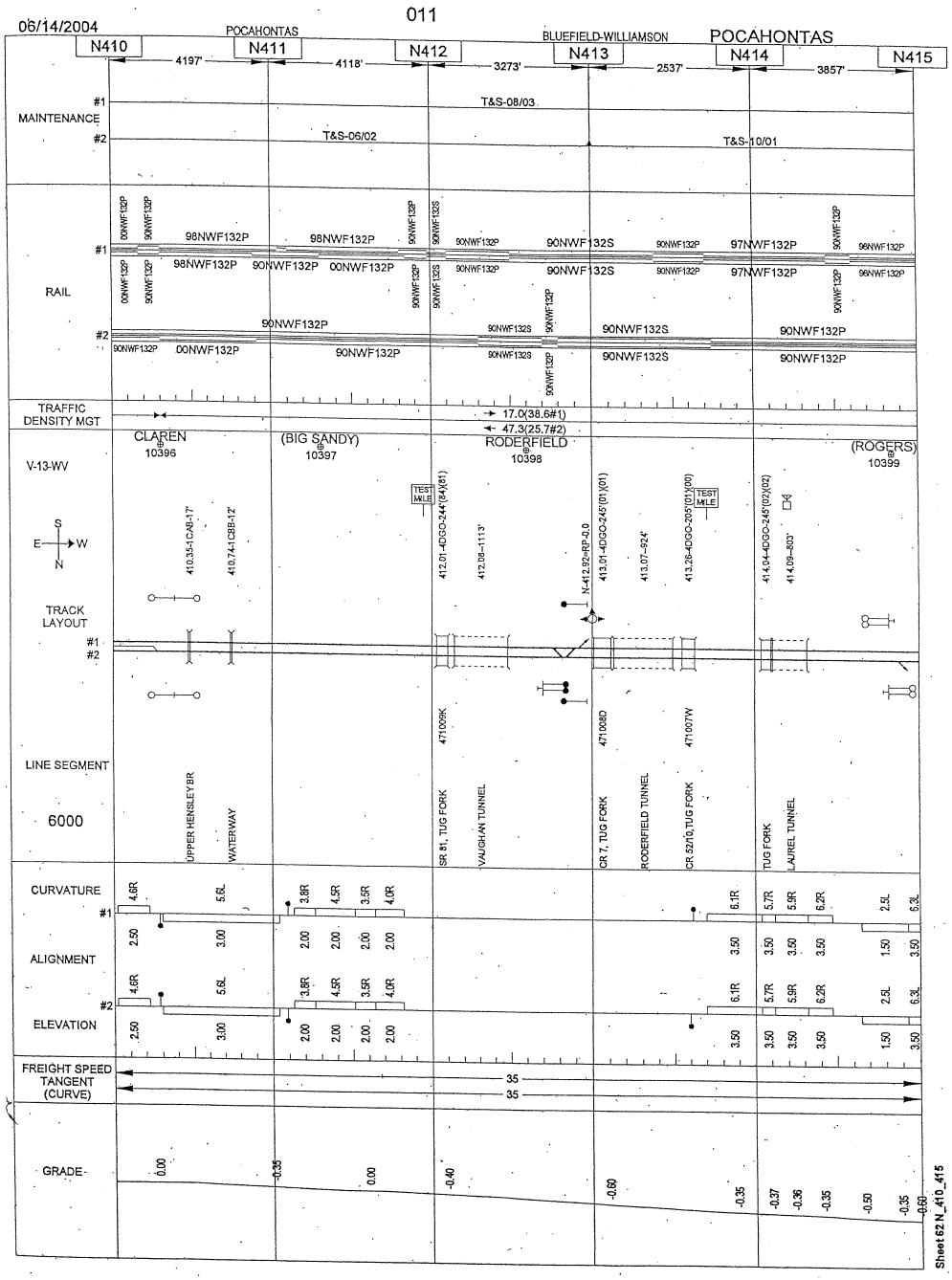


7. PHOTOS

Photo 1. East Portal

Photo 2. View from East Portal

Photo 3. West Portal

Photo 4. View from West Portal

Photo 5. Scaling at Vertical Construction Joint

Photo 6. Spall at Vertical Construction Joint, Moisture Evident

8. ESTIMATE

Roderfield

Tunnel Length	924	ft
Tunnel Width	27.5	ft
# of Tracks	2	

	Contractor		Railroad	
Work Window	10	hrs	10	hrs
Setup & Demobilization Allowance	2	hrs	2	hrs
Production Time	8	hrs	8	hrs

Tunnel Work Items	UOM	Quantity	Unit Rate	Total
Mobilization	%	5%		$41,551.57
Surveying	DY	5	$1,300.00	$6,500.00
Deep Notching	LF	1848	$218.14	$403,118.04
Rock Dowels 16'	EA	924	$286.04	$264,301.60
Rock Cut Drainage Trench	LF	1324	$88.97	$117,801.60
Tunnel Drainage	LF	1324	$17.29	$22,894.22
Demobilization	DY	5	$3,283.20	$16,416.00
Total Tunnel Work Items	**LF**	**924**	**$944.35**	**$872,583.04**

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Undercutting	PF	1900	$27.40	$52,059.44
Surfacing & Lining	PF	5700	$1.81	$10,304.06
Ballasting Track	TN	1900	$38.02	$72,231.32
Demobilization	DY			
Total Trackwork Items				**$134,594.82**

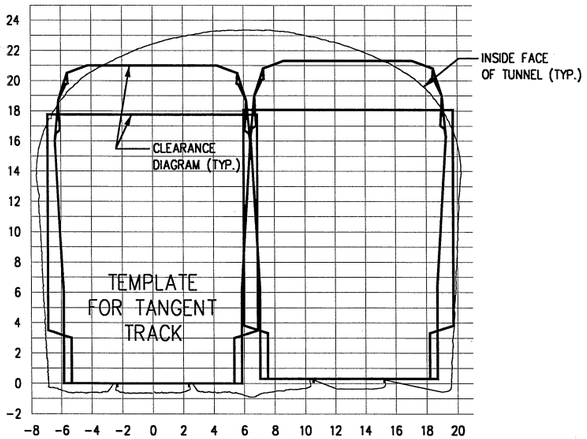
Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	924	$11.11	$10,265.18
Demobilization	DY			
Total Signal Items				**$10,265.18**

Site Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY	1	$2,483.60	$2,483.60
Erosion & Sedimentation Control	EA	1	$11,958.80	$11,958.80
Demobilization	DY			
Total Site Items				**$14,442.40**

Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	60	$821.50	$49,290.00
Flood Track with Ballast for Protection	TN	3800	$38.66	$146,926.06
Remove Flooded Ballast	TN	3800	$8.59	$32,632.61
Invert/Crown Void Grouting	DY	15	$4,448.80	$66,732.00
Demobilization	DY			
Total Specialty Items				**$295,580.66**

Subtotal All Items		**$1,327,466.11**
Construction Contingency	**30%**	**$398,239.83**
Engineering Allowance	**10%**	**$172,570.59**
Construction Management Allowance	**14%**	**$241,598.83**
Total		**$2,139,875.37**

9. DRAWINGS



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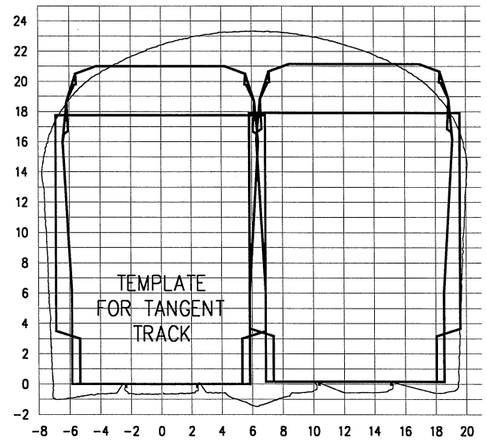

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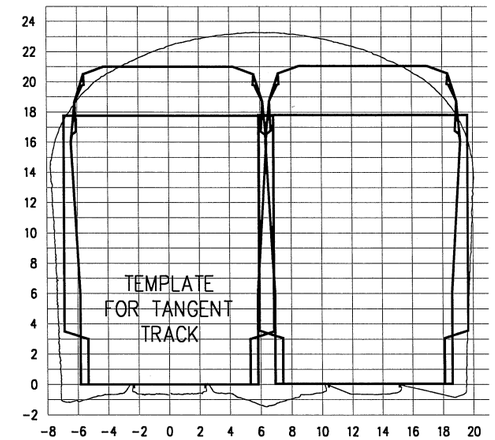

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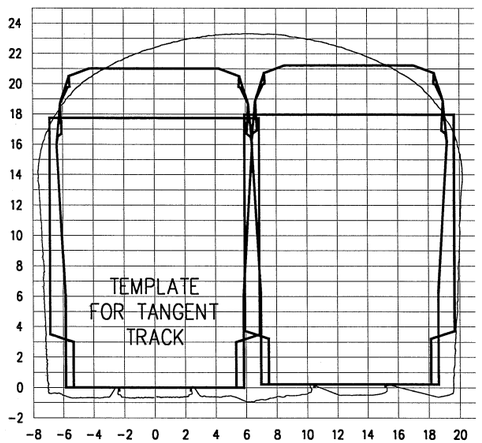

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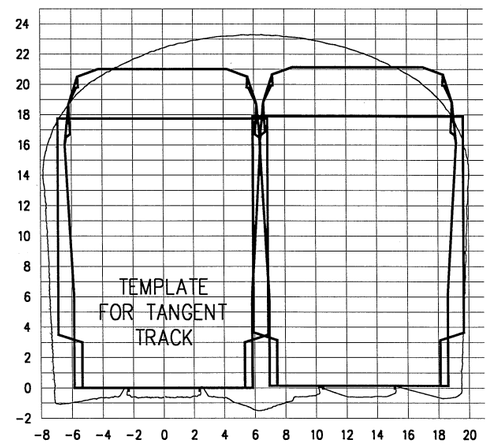

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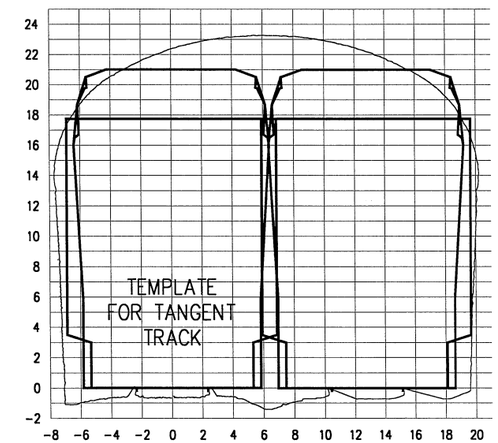

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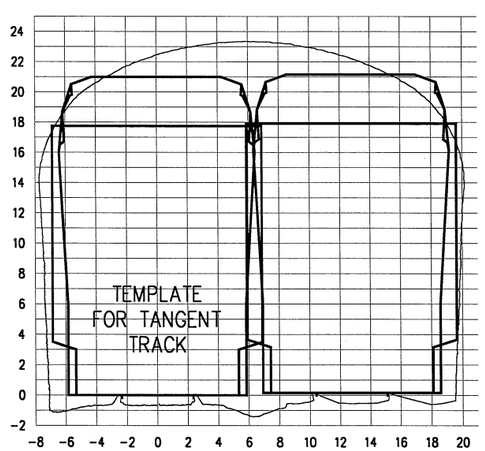

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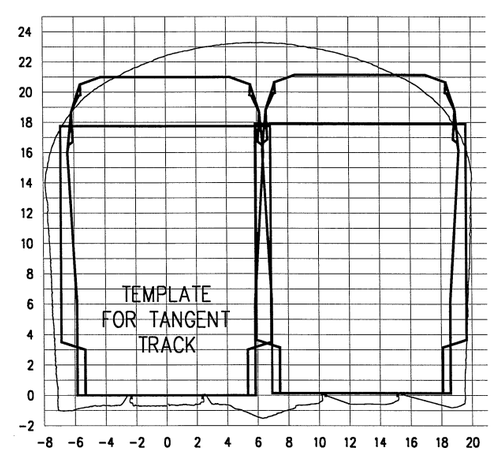

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NOTES:

1. HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
2. CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

NOT FOR CONSTRUCTION

SCALE: 1" = 100'

50 0 100 200 300

Hatch Mott MacDonald

NORFOLK SOUTHERN

OWNING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

REV	BY	DATE	DESCRIPTION
P1	FPF	7/19/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: RODERFIELD TUNNEL, RODERFIELD, WV

TITLE: TUNNEL CLEARANCE CROSS SECTIONS – 1 OF 3

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DWN | FILE No. | DRAWING NUMBER
CHK | DATE APRIL 22, 2005

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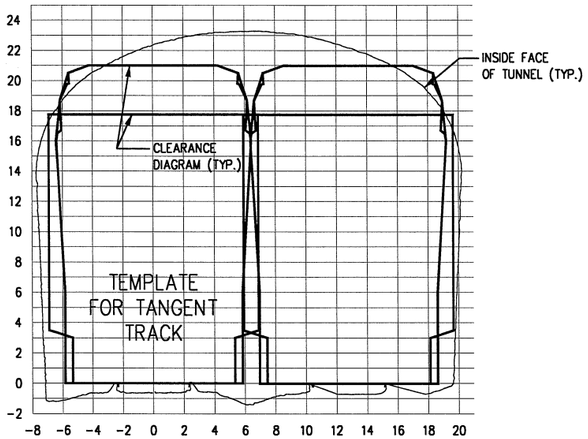

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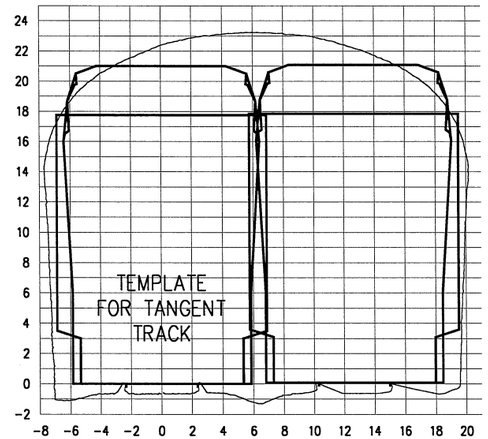

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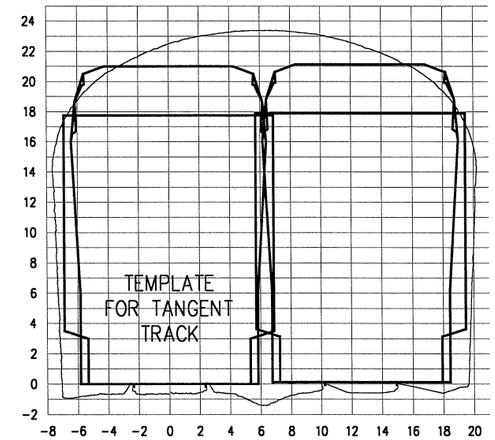

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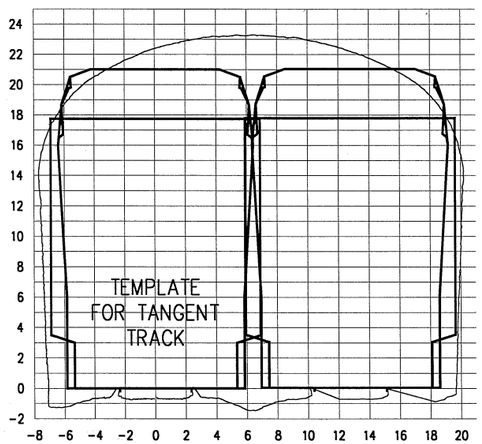

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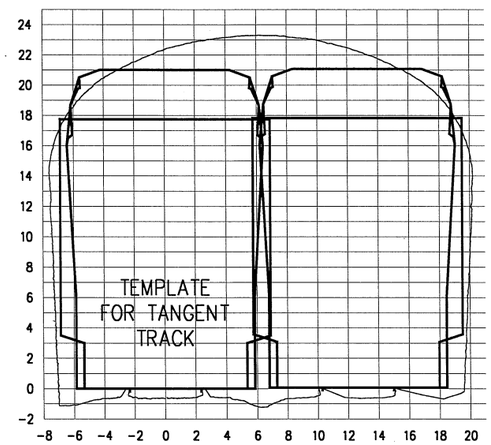

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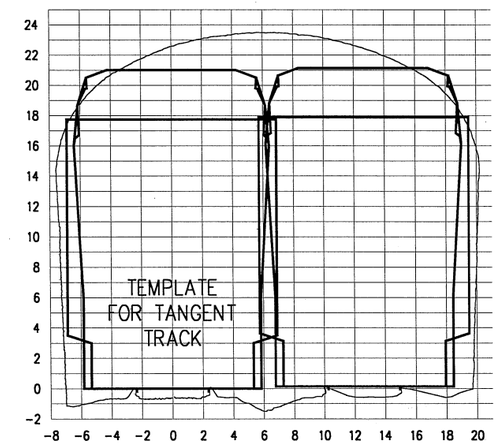

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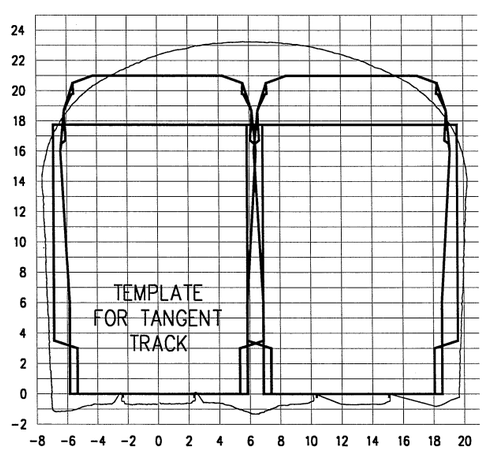

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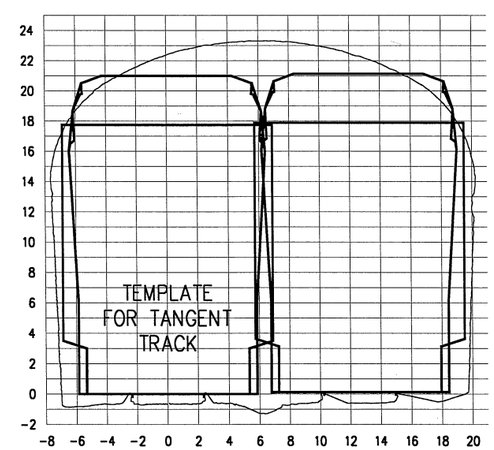

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NOTES:

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SCALE: 1"=100'

50 0 100 200 300

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REV	BY	DATE	DESCRIPTION
P1	FPF	7/19/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: RODERFIELD TUNNEL, RODERFIELD, WV

TITLE: TUNNEL CLEARANCE CROSS SECTIONS - 2 OF 3

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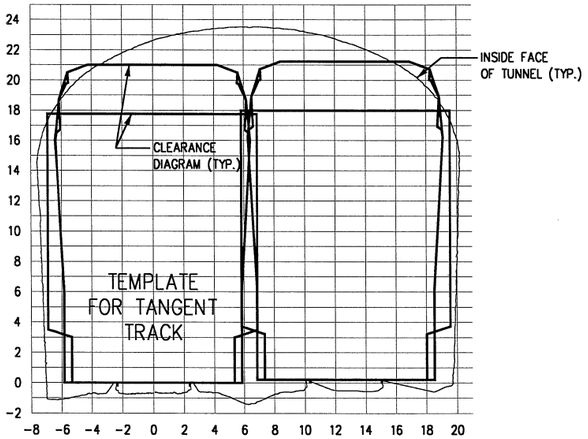

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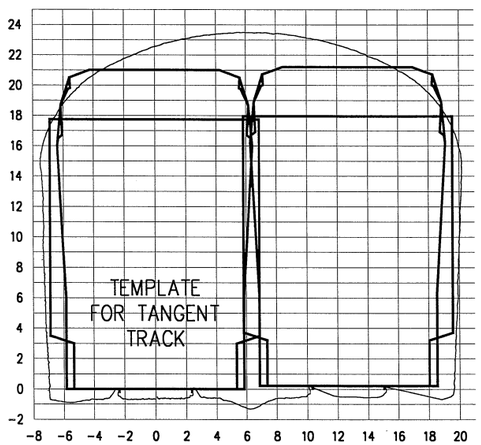

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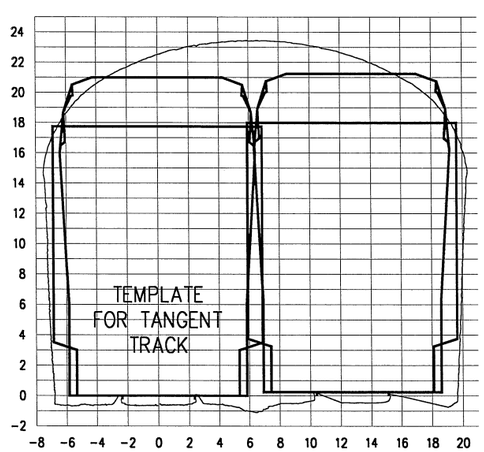

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REV	BY	DATE	DESCRIPTION
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LOCATION: RODERFIELD TUNNEL, RODERFIELD, WV

TITLE: TUNNEL CLEARANCE CROSS SECTIONS - 3 OF 3

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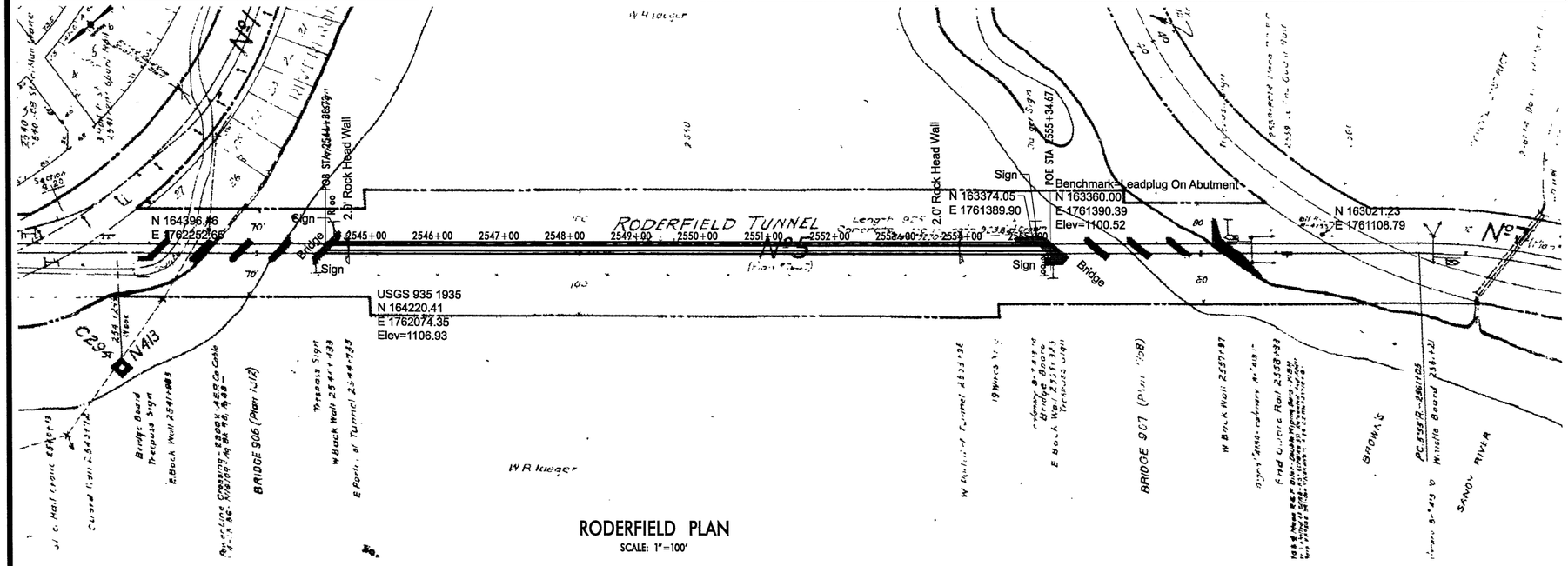


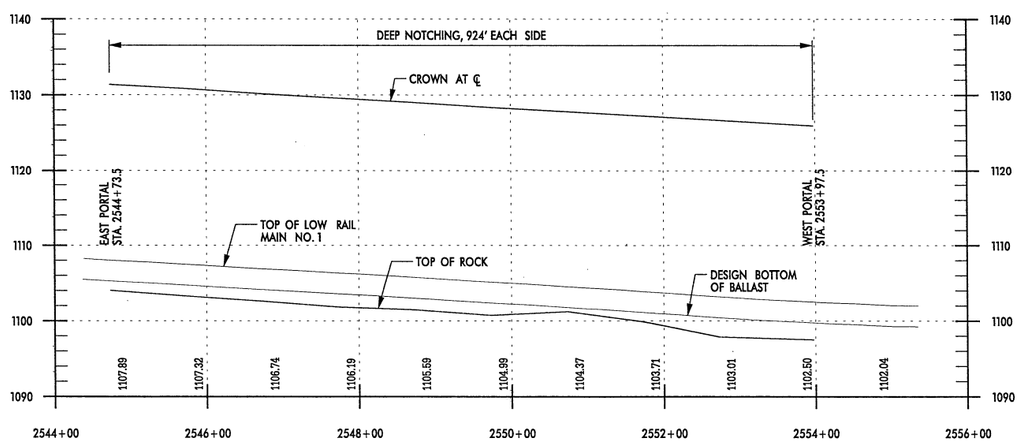
RODERFIELD PLAN

SCALE: 1"=100'

RODERFIELD CENTERLINE DATA

Horizontal Alignment Name: 3
Description:
Style:
Input Factor: 1.0000

	STATION	NORTHING	EASTING
Element: Linear			
POB (2)	2544+38.73	164192.37	1762079.74
POE (1)	2555+34.67	163354.51	1761373.29
Tangent Direction	220°08'11"		
Tangent Length	1095.94		



RODERFIELD PROFILE

SCALE: 1"=100' HORIZ.
1"=10' VERT.

NOT FOR CONSTRUCTION

SCALE: 1"=100'

50 0 100 200 300

Hatch Mott MacDonald

NORFOLK SOUTHERN

OWNING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

REV	BY	DATE	DESCRIPTION
P2	DJL	101405	PRELIMINARY ENGINEERING PHASE REPORT
P1	DJL	7/19/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: RODERFIELD TUNNEL, RODERFIELD, WV

TITLE: PLAN AND PROFILE

DGN | PID No. | VRN 16293 & 1629301 | MILE POST N-413.07
DWN | FILE No. | DRAWING NUMBER
CHK | DATE APRIL 22, 2005

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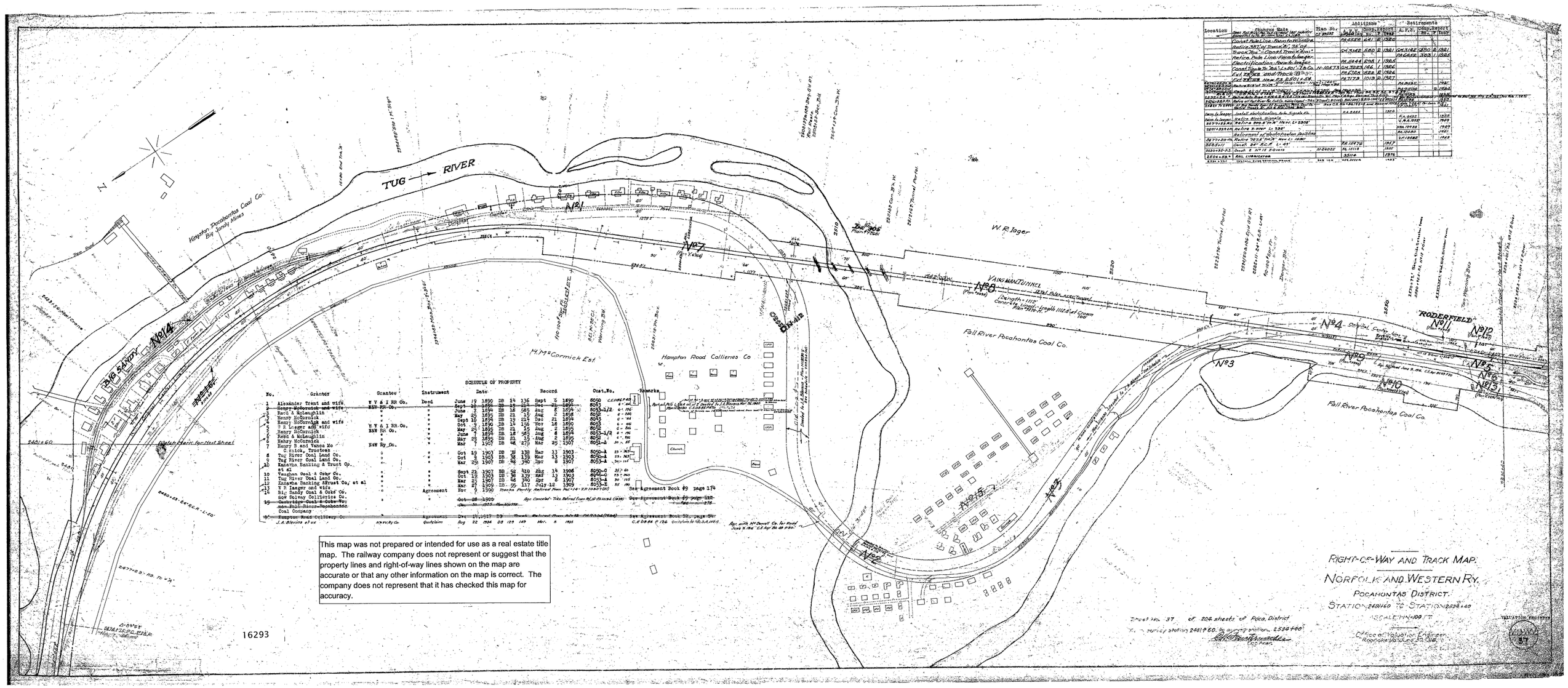

Location	Changes Made	Plan No.	Additions				Retirements			
			Acct. No.	Cost	Comp. Report No.	Year	Acct. No.	Cost	Comp. Report No.	Year
	Const. Pole Line - Const. Telephone	LE 20235	PA 5372	641	18	1924				
	Const. Pole Line - Const. Telephone		PA 5372	641	18	1924				
	Relice 387 of Track No. 75 of Track No. - Const. Track Misc.		CM 5142	680	2	1921	CM 5142	680	2	1921
	Relice Pole Line - Const. Telephone						PA 6452	302	1	1922
	Electrification - Points Jager		PA 5444	298	1	1925				
	Const. Signals Tel. Lines - Pocahontas Co.	N-10673A	CM 5223	142	1	1924				
	Ext. 75" Const. Track 75		PA 5783	622	2	1926				
	Ext. 75" Const. Track 75		PA 7179	1013	2	1927				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	PA 6436			1921
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	PA 6002		2	1920
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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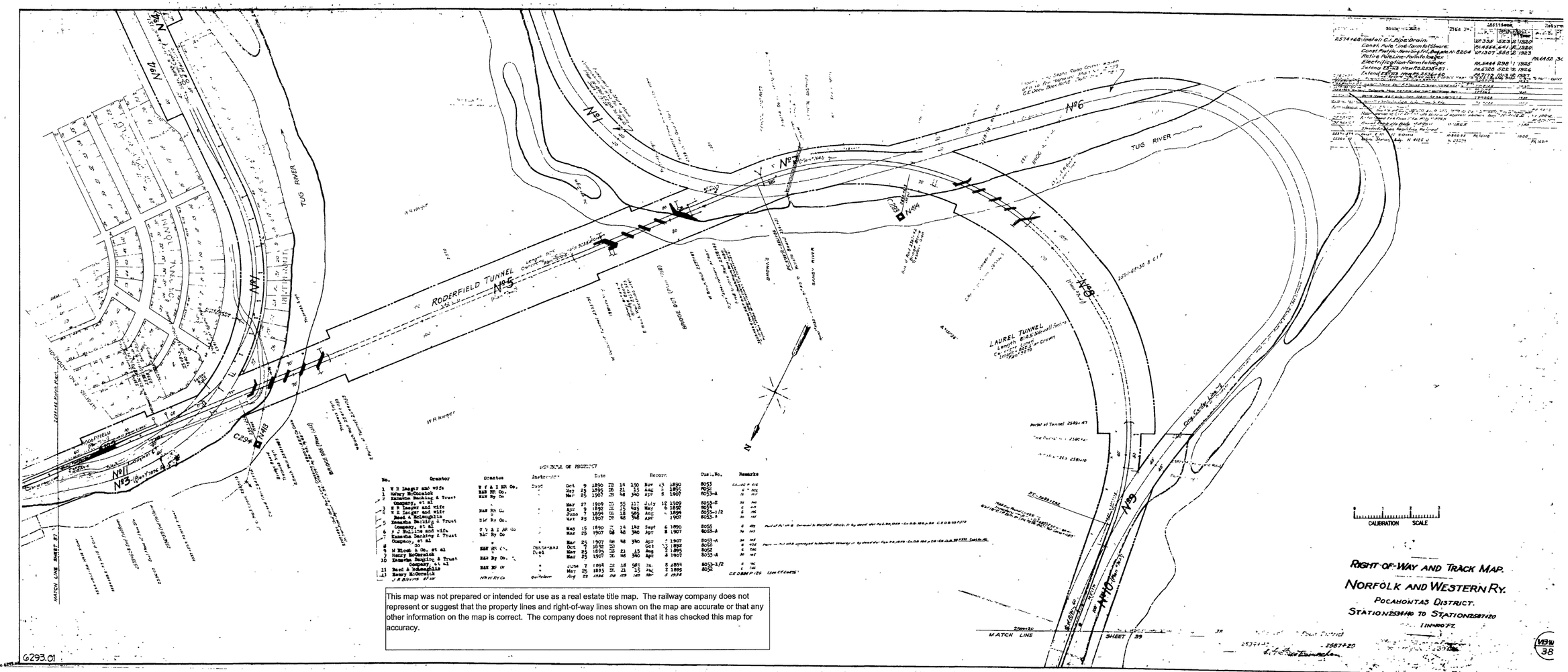
Jager to Jager	Install electrification, Auto Signals etc.		PA 5444			1925				
Jager to Jager	Relice Block Signals						PA 6452			1922
247+125 Rt.	Relice 300.8" "Th" New L= 1200'						U.R.R. 1112			1949
2801+25 Rt.	Relice R-over L= 320'						VRR 19122			1949
	Relinement of Protection Facilities						RL 10450			1921
247+22 Rt.	Relice 723.5" "Th" New L= 1280'						VR 19582			1949
2533+11	Const. 24" R.C.P. L= 41'		RL 13472			1927				
2520+35 P.S.	Const. 2 NP 12 P-over	N-24022	RL 13118			1925				
2504+29 ±	RAIL LUBRICATOR		35114			1876				
2520+35 ±	[illegible]	[illegible]	[illegible]			1923				

SCHEDULE OF PROPERTY

No.	Grantor	Grantee	Instrument	Date				Record				Cust. No.	Remarks
1	Alexander Trent and wife	N Y & I RR Co.	Deed	June	19	1890	DB	14	136	Sept	5	1890	8050
2	Henry McCormick and wife	NSW RR Co.	"	Sept	10	1894	DB	18	214	Dec	21	1894	8053
3	Reed A McLaughlin	"	"	June	7	1894	DB	18	585	Aug	2	1894	8053-1/2
3	Henry McCormick	"	"	May	29	1895	DB	21	15	Aug	2	1895	8052
4	Henry McCormick and wife	"	"	Sept	10	1894	DB	19	214	Dec	21	1894	8053
5	T B Jager and wife	N Y & I RR Co.	"	Oct	9	1896	DB	14	156	Nov	18	1896	8053
5	Henry McCormick	NSW RR Co.	"	May	29	1895	DB	21	15	Aug	2	1895	8052
6	Reed A McLaughlin	"	"	June	7	1894	DB	18	585	Aug	2	1894	8053-1/2
6	Henry McCormick	"	"	May	29	1895	DB	21	15	Aug	2	1895	8052
7	Henry B and Vanoa Mc C rick, Trustees	"	"	Mar	7	1907	DB	48	270	Mar	25	1907	8051-A
8	Tug River Coal Land Co.	"	"	Oct	19	1907	DB	35	138	Mar	13	1903	8050-A
9	Tug River Coal Land Co.	"	"	Oct	3	1903	DB	32	139	Mar	13	1903	8050-A
10	Kanawha Banking & Trust Co. et al	"	"	Mar	29	1907	DB	48	340	Apr	8	1907	8051-A
10	Vaughan Coal & Coke Co.	"	"	Sept	23	1907	DB	52	310	Apr	14	1908	8050-C
11	Tug River Coal Land Co.	"	"	Oct	19	1903	DB	32	139	Mar	13	1903	8050-A
12	Kanawha Banking &Trust Co, et al	"	"	Mar	29	1907	DB	48	340	Apr	8	1907	8051-A
13	W R Jager and wife	"	"	Mar	27	1909	DB	55	117	July 12		1909	8051-E
14	Big Sandy Coal & Coke Co. now Solvay Collieries Co.	"	Agreement	Nov	9	1900							See Agreement Book 49 page 174
15	~~Cambridge Coal & Coke Co. now Big River Pocahontas Coal Company~~	"	"	~~Oct~~	~~28~~	~~1909~~							~~See Agreement Book 49 page 175~~
16	Hampton Road Collieries Co.	"	Agreement	Dec	17,	1917	DB						See Agreement Book 52, page 54
	J. A. Blevins et ux	NSW Ry. Co.	Quitclaim	Aug	22	1924	DB	125	149	Mar.	5	1925	C.R. 0584 P. 126

This map was not prepared or intended for use as a real estate title map. The railway company does not represent or suggest that the property lines and right-of-way lines shown on the map are accurate or that any other information on the map is correct. The company does not represent that it has checked this map for accuracy.

16293



No.	Grantor	Grantee	Instrument	Date	Record	Cus. No.	Remarks
1	W R Iaeger and wife	W V & I RR Co.	Deed	Oct 9 1890	BK 14 PG 390	Nov 13 1890	B053
1	Henry McCormick	NAN RY Co.	"	May 25 1896	BK 21 PG 15	AUG 1 1895	B052
2	Kanawha Banking & Trust Company, et al	NAN Ry Co	"	Mar 25 1907	BK 48 PG 340	Apr 5 1907	B053-A
3	W R Iaeger and wife	NAN RY Co.	"	Mar 27 1909	BK 55 PG 117	July 12 1909	B053-B
4	W R Iaeger and wife	NAN RY Co.	"	Apr 9 1892	BK 15 PG 425	May 6 1892	B053
	Reed A McDonald			June 7 1894	BK 18 PG 562	Aug 1 1894	B053-1/2
5	Kanawha Banking & Trust Company, et al	NAN Ry Co.	"	Mar 25 1907	BK 48 PG 340	Apr 5 1907	B053-B
6	J J Sullins and wife	N V & I RR Co	"	May 15 1890	BK 14 PG 182	Sept 6 1890	B050
7	Kanawha Banking & Trust Company, et al	NAN Ry Co	"	Mar 25 1907	BK 48 PG 340	Apr 5 1907	B055-A
8	do	"	"	Mar 25 1907	BK 48 PG 340	Apr 5 1907	B053-A
9	M Bloch & Co. et al	NAN RY Co.	Contract and	Oct 7 1898		Oct 12 1898	B050
7	Henry McCormick	"	Deed	Nov 25 1895	BK 23 PG 15	Aug 5 1895	B052
10	Kanawha Banking & Trust Company, et al	NAN Ry Co.	"	Mar 25 1907	BK 48 PG 340	Apr 5 1907	B052-A
11	Reed A McDonald	NAN RY Co	"	June 7 1894	BK 18 PG 562	Aug 8 1894	B053-1/2
11	Henry McCormick	"	"	May 25 1895	BK 23 PG 15	Aug 5 1895	B052
	J A Morris et ux	N&W Ry Co	Quitclaim	Aug 22 1934	BK 105 PG 145	Nov 5 1934	CE DBM P-125 (SEE REMARKS)

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